Marking schemes

Senior league

Problem 1
Proving the inequality only for x in the range of G: 2 points
Proving the inequality only for odd degrees of G: 2 points
These points are not additive.

Problem 2
Proving the similarity of triangles AEM, MCB, DMG: 1 point

Problem 3
Use of any inequalities not turning to equalities for numbers in the problem: 0 points

Problem 4
Proving the that two sets contain equal number of elements: 1 point
Any algebraic reformulations of the problem: 0 points

Problem 5

Problem 6
Correct answer and an example for $n+2$ points (without proof): 1 point
Only an example (with proof) or only a proof of maximality: 3 points
Any attempts to give an example or prove maximality with a wrong answer: 0 points

Problem 7
$AX \parallel BY$ or an equivalent claim is explicity stated and proved: 1 point
Proving that $QB + AP \geq 2PX$: 1 point
Proving that $XY \parallel PQ$: 0 points

Problem 8
P_n is expressed through P_1 and P_2: 0 points
The roots of all P_n are proved to be different: 1 point
The problem is reduced to the case when the ratio of leading coefficients of P_1 and P_2 is $-\frac{1+\sqrt{5}}{2}$: 3 points (not additive with the previous item)
1 point was deducted for minor logical and computational errors

Junior league

Problem 1

(1) Proving that $F(x) \neq G(x)$ for all x: 3 points

(2) Explicitly noted that $F(x) > G(x)$ for all x in the range of G: 2 points

(1) and (2) are not additive when continuity is not used.

Problem 2

Proving that ABF is isosceles: 1 point

Problem 3

A: example

(A1) Correct example without description of ALL triplets satisfying the condition and without counting them: 0 points

(A2) Correct example with description of ALL triplets satisfying the condition, without counting them: 1 point

(A3) Correct example with description of ALL triplets satisfying the condition and counting them (not necessarily in a closed form): 2 points

These items are not additive.

B: maximality

(B1) Proving that a_k cannot divide both $a_j + a_k$ and $a_j + a_i$ for $i < k < j$: 0 points

(B2) Proving that a_k cannot divide $a_i + a_j$ for $i < j \leq k$: 1 point

(B3) Proving that for fixed $j > k$ the number a_k can divide at most one sum of the form $a_i + a_j$, $i \leq k$: 3 points

These items are not additive.

(C) In a complete solution 1 point was deducted if the answer was not given in a closed form.

(D) An answer (in any form) without proof: 0 points

Problem 4

Examples of arranging knights and liars in particular graphs: 0 points

Problem 5

A correct example without justification: 3 points

2 points are deducted when it is claimed without proof that the squares of the main diagonal must remain on the main diagonal

Problem 6

Special cases (n being product of a fixed number of primes and so on): 0 points

The case when n is a product of at most 99 primes: 0 points

The idea of uniting the smallest primes: 1 point

Problem 7

Claiming that the number of moves is always even when 3 divides the number of stones in a pile, and odd otherwise: 3 points

Problem 8

$AX \parallel BY$ or an equivalent claim is explicity stated and proved: 1 point

Proving that $QB + AP \geq 2PX$: 1 point

Proving that $XY \parallel PQ$: 0 points